Special issue of the International Conference on Computational and Experimental Science and Engineering (ICCESEN 2014)

Barite Effect on Radiation Shielding Properties of Cotton–Polyester Fabric

İ. Akkurt[a,*], S. Emiköne[a], F. Akarslan[b], K. Günoğlu[c], Ş. Kilinçarslan[b] and İ.S. Üncü[d]

[a]Suleyman Demirel University, Science Faculty, Isparta, Turkey
[b]Suleyman Demirel University, Engineering Faculty, Isparta, Turkey
[c]Suleyman Demirel University, Technical Vocational School, Isparta, Turkey
[d]Suleyman Demirel University, Technological Faculty, Isparta, Turkey

Since creation of universe there has been radiation around us and this rate is getting higher with the development of technology. Thus radiation shielding becomes important subject for researcher. Besides normal people especially radiation workers in nuclear facilities need extra protection from radiation. This is vital if we think about any kind of nuclear leakage or nuclear attack, fabric becomes very important. For this purpose, cotton–polyester type of fabric has been coated by barite and gamma ray attenuation efficient has been obtained. The fabric was coated in different rate of barite (0%, 40%, 50% and 60%) in order to test effect of barite rate on the fabric. The measurement has been performed for gamma ray energy of 511, 662, and 835 keV using gamma spectrometer system with NaI(Tl) detector. It was found that the attenuation coefficient has increased with the barite coating rate on fabric.

DOI: 10.12693/APhysPolA.128.B-53
PACS: 42.82.Cr, 81.05.–t

1. Introduction

With progress of technology, radiation has been used in a variety of different fields and thus people are under health risk. In order to protect from radiation three basic parameters are used. Those are time, distance, and shielding. Worker in especially critic field such as hospital needs to wear material which can absorb radiation. Fabric containing heavy element such as lead is used for these purposes and an alternative way could be coating of a fabric which can be done using a variety of different materials such as plastic, plastic films, etc. [1, 2].

Barite has been used to coat fabric in this study as its radiation shielding properties is important due to the $BaSO_4$. Barite is white and most massive one in minerals family [3, 4].

2. Experimental details

Barite prepared in μm scale coated fabric. The fabric was cotton–polyester type. The fabric was placed in a place to be coated. In Table barite rate has been detailed in coating process. After coating process the fabric was dried.

The linear attenuation coefficients of coated cotton–polyester fabric was measured using gamma spectrometer containing NaI(Tl) detector. The radiation source were ^{22}Na, ^{137}Cs, and ^{54}Mn which emit 511, 662, and 835 keV gamma rays. A schematic view of the system is displayed in Fig. 1.

TABLE

Barite rate on coating.

Fabric types	Barite rates [%]
cotton–polyester	0
	40
	50
	60

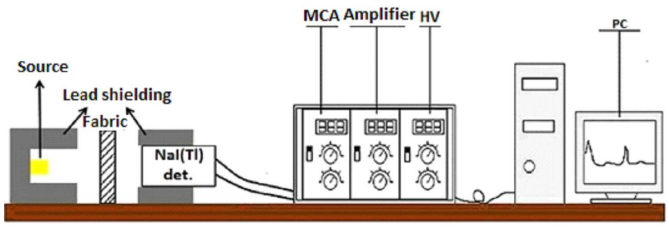

Fig. 1. Gamma spectrometer.

From the spectrum obtained from detector the linear attenuation coefficients are determined using the Beer–Lambert formula

$$I = I_0 \, \mathrm{e}^{-\mu x}. \tag{1}$$

Here μ is the linear attenuation coefficient, x — thickness, I_0 — number of gamma quanta emitted from source and I is number of gamma quanta hitting detector.

*corresponding author; e-mail: iskenderakkurt@sdu.edu.tr

3. Results and discussions

In this study cotton–polyester fabric was coated with different rates of barite and radiation shielding properties were measured at 511, 662, and 835 keV energies. The results of linear attenuation coefficients are displayed in Fig. 2.

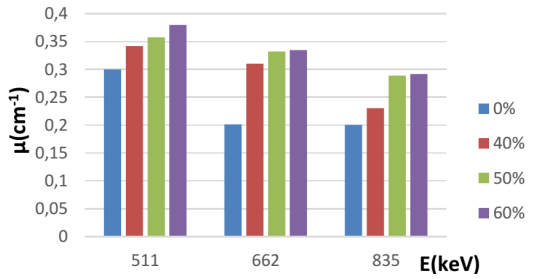

Fig. 2. Linear attenuation coefficients of fabric for 511, 662, and 835 keV energies.

It can be seen from this figure that linear attenuation coefficients are increased with the increase of barite rate on coating. It is clearly seen from this work that barite coating method is useful way to develop fabric radiation shielding properties.

Acknowledgments

This work has been supported by Suleyman Demirel University Foundation Unit under project number of 3812_YL2_13.

References

[1] I. Akkurt, F. Akarslan, K. Günoğlu, Ş. Kılınçarslan, I. Serkan Uncü, H. Demiralay, *Süleyman Demirel Üniversity J. Nat. Appl. Sc.* **17**, 63 (2013).

[2] B.H. Gürcüm, *Textile Material Information*, 1st ed., Grafiker Ofset, Ankara 2005.

[3] Ş. Kılınçarslan, S. Sancar, İ. Uzun, in: *Proc. 6th Int. Advanced Technologies Symp. (IATS'11)*, Elazığ (Turkey), Elazığ 2011.

[4] *Türkiye Barit Envanteri*, M.T.A. Enst. Yay., No. 163, Ankara 1976.